AUTOMATED APPARATUS AND SYSTEM FOR COOKING, DRYING, PEELING AND PROCESSING SHELLFISH PRODUCTS

Field and Background of the Invention

The present invention relates generally to shrimp processing and, more specifically, to a method and apparatus for boiling, drying, peeling and size grading shellfish products such as shrimp and crawfish while simultaneously utilizing the by-products to process broth and salt. The present invention includes a fully automated means for processing shrimp, broth, salt, food additives such as shrimp broth and flavors extracted from heads & shells for natural flavored products for oils and other product enhancements, animal feed and fertilizer and moving the product from the loading dock to a finished product storage area without the need of human contact with the product thereby greatly reducing the risk of contamination and the cost of labor.

The procedures currently being used for processing shrimp require having personnel and employees manually dump the product into a conk tank and transfer it from one processing system into the next thereby exposing the food product to sweat, saliva, respiratory germs and the like. Furthermore, airborne contaminants also come in contact with the food product during processing, increasing the risk of causing sickness and disease to the consumer.

Furthermore, airborne contaminants also come in contact with the personnel during processing thereby increasing the risk of respiratory disease associated with the inhalation of sodium bisulphate and other harmful airborne contaminants.

The present invention seeks to alleviate these inherent dangers by eliminating the need for workers to come in contact with the product and providing a plurality of vacuums and cleaning systems to ensure a clean environment during processing. Automated conveyors serve to move the product from one system to the next from the loading dock to the drying system.

Each system involved in the processing is independent from the others and the conveyors are not attached thereby allowing a facility to upgrade current equipment to the completely automated system in steps.

There are other shellfish processing means known in the art. While these shrimp processors may be suitable for the purposes for which they were designed, they would not be as suitable for the purposes of the present invention, as hereinafter described.

Summary of the Present Invention

A primary object of the present invention is to provide a method and apparatus for processing shellfish that will add automation to the current process.

Another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that greatly reduces heat within the work area.

Yet another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that eliminates the contamination of product during the current drying system due to condensation which accumulates on ceiling and then drops onto product.

Still another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that eliminates the exposure to excessive perspiration from employees, which currently falls directly onto product while loading, raking (rotating) and unloading.

Yet another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that eliminates air contamination within the work area due to shrimp dust and possible preservatives such as sodium bisulphate that fishermen apply to raw product and that become airborne during the process.

Another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that eliminates the hands-on labor of loading and unloading raw product into the boiling system.

Still another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that eliminates the hands-on labor of loading and unloading boiled seafood into dryers.

Yet another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that eliminates the hands-on labor of loading and unloading of dried product into the peeling device.

Another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that eliminates the hands-on labor of rotating the product every thirty minutes during the drying process.

Still another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that eliminates the contamination transfer of shrimp dust from previous batches of product to subsequent batches of product.

Yet another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that eliminates the over-drying of smaller product and the under-drying of larger product while offering a perfectly dried product based on size.

Another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that eliminates the hands-on labor of hand picking debris from the finished product up to 66% above the present means.

Still another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that adds an additional smaller size of product, which is normally lost in the peeling process, thereby increasing the yield.

Yet another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that eliminates the breaking of the tips of the tails of the product, thereby having a great impact on the yield increase.

Another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that offers a cleaner product without damaging the finished product thereby removing the legs, heads and shells while leaving the tails intact.

Still another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that adds an easy means of sanitizing between batches of product whereas the prior art has no sanitizing means whatsoever.

Yet another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that eliminates the hands-on labor of sweeping up peelings and shrimp dust for shipment by packing the peelings and dust in 50-gallon drums.

Another object of the present invention is to provide a fully automated method and apparatus for processing. Shrimp and crawfish that offers a more cost-effective and energy-efficient process of drying by utilizing residual heat from the boilers and broth system to heat the dryers.

Still another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that will reduce the cost of the product on the consumer end thereby making it a more desirable product.

Another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that eliminates human contact therewith, thereby reducing the risk of contamination and the cost of labor.

Still another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish wherein crates of iced shrimp are placed on a conveyor belt on the loading dock and transported to a tilt-dumping cage at the end thereof into which they are dropped so that the shrimp and ice fall into a conk tank and the crate is subsequently tossed aside by a removal bar to make room for the following crate thereby negating the need of manually dumping the product into the conk tank.

Yet another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish including a conk tank filled with water wherein jetted water is used to separate conk shells and other heavy items which become trapped in the bottom of the tank while the lighter items which respond to the agitated water are moved to the transport system.

Still another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish wherein the conk tank includes a conveyor system to transport the product to a primary seafood boiler.

Another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish wherein the primary seafood boiler cooks the product at a predetermined temperature for a selected amount of time while jetted air serves to stir it during the boiling process.

Yet another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish wherein the primary seafood boiler is supplied and replenished with brine or salt water (water with salt added) that is mixed in a brine mixing tank and stored in auxiliary boilers to maintain the fresh brine at a specific temperature until such time that it is to be introduced into the primary seafood boiler.

Still another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish including a spray drying system wherein brine is extracted from the primary seafood boiler and injected into a heated furnace or hopper as a fine mist where it is almost immediately dehydrated thereby creating a solid product to be used as a seafood flavored salt or additive.

Another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish wherein the product is transferred from the primary seafood boiler via a seafood dryer conveyor system where it is spread out and stirred by a plurality of spreader bars and rakes as it is cooled by high speed fans to terminate the cooking process in a thorough, uniform manner.

Yet another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish wherein the product is transferred to dryers from the primary seafood boiler by a conveyor system rather than manually as is the current method used in the industry.

Still another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish wherein the product is dried in stacked dryers and rotated periodically at a predetermined rate to ensure even drying.

Another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish wherein the product is dried in spiral dryers that move the product in a spiral rotation to the top of the dryer where it is dumped through a chute back to the bottom and reloaded as the process is repeated.

Still another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that will vacuum dried product from the traditional box dryers into the peeling device described in this process.

Another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that is to vacuum dried product from the traditional tumbler peelers previously being used.

Yet another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish wherein the dryers may be piggybacked with the product being transferred from one dryer to the next.

Still another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish wherein the product is transferred from the dryers to a peeling device that will de-shell the product while keeping the tails intact.

Another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish wherein the peeling device includes a spinning blade that causes the cleaned product to ride along the sides of an inner compartment which is

smooth and allow the unclean product which is heavier and bulky to remain on the screen area.

Yet another object of the present invention is to provide a fully automated method and apparatus for producing an oil having a flavor corresponding to a type of shellfish being processed. The oil is produced by utilizing shellfish heads, tails, legs and shells that have been peeled by a peeling device and collected therein. The collected products are pulverized and simmered in an neutral oil, and upon being heated the flavor from the remaining meat contained in each byproduct is transferred into the oil thereby producing a shellfish flavored oil.

A further object of the present invention is to provide a fully automated method and apparatus for producing a shellfish flavored oil wherein a further flavoring element is added to the shellfish oil to further adjust the flavor thereof. This further flavor element includes but is not limited to at least one of lemon, garlic, butter and hot-n-spicy flavorings.

Still yet a further object of the present invention is to provide a system able to process shellfish product wherein the shellfish is at least one of shrimp, including Fresh Water Shrimp, Rock Shrimp, Cold Water Shrimp, Warm water Shrimp, prawns, crabs, and crawfish.

Still another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that is simple and easy to use.

Still yet another object of the present invention is to provide a fully automated method and apparatus for processing shrimp and crawfish that is inexpensive to manufacture and operate.

Additional objects of the present invention will appear as the description proceeds.

The foregoing and other objects and advantages will appear from the description to follow. In the description reference is made to the accompanying drawings, which forms a part hereof, and in which is shown by way of illustration specific embodiments in which the invention may be practiced.

These embodiments will be described in sufficient detail to enable those skilled in the art to practice the invention, and it is to be understood that other embodiments may be utilized and that structural changes may be made without departing from the scope of the invention. In the accompanying drawings, like reference characters designate the same or similar parts throughout the several views.

The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present invention is best defined by the appended claims.

Brief Description of the Drawing Figures

In order that the invention may be more fully understood, it will now be described, by way of example, with reference to the accompanying drawings in which:

FIGURE 1 is a schematic diagram of the present invention;

FIGURE 2 is a diagrammatic view of the product from the loading dock to the primary seafood boiler;

FIGURE 3 is a block diagram of the boiler system;

FIGURE 4 is a block diagram of the heat exchange system;

FIGURE 5 is a block diagram of the present invention;

FIGURE 6 is a block diagram of the dryer and its related components;

FIGURE 7 is a front view of the peeling device and associated options;

FIGURE 8A - 8C is a block diagram showing the components and relationship for the seafood processing system;

FIGURE 9 is a block diagram of the brine broth processing system;

FIGURE 10A - 10B is a block diagram of the heat recovery system; and

FIGURE 11 is a block diagram for processing the seafood byproducts.

Description of the Preferred Embodiment

The following discussion describes in detail one embodiment of the invention. This discussion should not be construed, however, as limiting the invention to those particular embodiments; practitioners skilled in the art will recognize numerous other embodiments as well. For definition of the complete scope of the invention, the reader is directed to appended claims.

FIGURE 1 is a schematic diagram of the present invention 10. Raw product 18 is crated in ice and introduced to the present invention 10 at a refrigerated loading dock 12 where raw product testing 46 is randomly performed to check for contaminants prior to being transferred to a conk tank 14 that serves to separate heavier items such as conk shells that become trapped in the lower section thereof. Jetted water 16 is injected into the conk tank 14 to agitate the contents therein, thereby moving the product 18 to a conk tank conveyer 20 for transferal to a primary seafood boiler 22 filled with a brine 24 mix of salt and water that is prepared in brine mixing tanks 26 and stored in auxiliary boilers 28 to maintain the brine 24 at a specific temperature until ready for distribution to the primary seafood boiler 22. Once the product 18 is fully cooked, it is transferred to at least one dryer 30, with all dryers 30 supplied with hot air by an air return system 32 that transfers residual heat from all related heat generating equipment such as the boilers 22,28, the broth processing system 34 and the like. The product 18 is subsequently delivered to the peelers 36 for de-shelling once adequately dried by means of a product transfer system 38 that initially vacuums the smaller product 18 from the dryers 30 and continues to separate the product 18 by size as the suction of the vacuum gradually increases, thereby enabling the transfer system 38 to lift increasingly larger product 18 to the peeler 36. The transfer system 38 is filtered to remove harmful contaminates such as bisodium sulfate.

Used brine 24 is removed from the primary seafood boiler 22 and transported to a broth processing system 34 for the development of a seafood flavored broth 40 that is then stored in broth storage tanks 42 prior to broth packaging 44.

FIGURE 2 is a diagrammatic view of the movement of the product 18 from the refrigerated loading dock 12 to the primary seafood boiler 22 of the present invention 10. The product 18 is delivered to the loading dock conveyor 50 packed in crates 52 with ice 54 and transported to the inclined dumping cage conveyor 56 and tumbles into the dumping cage 58 thereby allowing the ice 54 and product 18 to fall into the conk tank 14. The dumping cage 58 then rejects the empty crate 52 and tosses it aside to allow the following crate 52 to drop therein. A plate-like vertical ice guard 62 traverses the width of the conk tank 14 and extends above and below the water surface to prevent the floating ice 54 from contacting the conk tank conveyor 20. The product 18 travels along on the conk tank conveyor 20 and is then delivered into the primary seafood boiler 22 where it is cooked at a predetermined temperature for a specific amount of time.

At least one agitation means, such as the paddle wheel 60 shown, is provided to stir the product 18 to allow for the uniform cooking thereof.

Figure 3 is a block diagram of the boiler system 21 demonstrating the fluid connections through conduit 66 from the brine mixing tank 26 to the auxiliary tanks 28 and the primary seafood boiler 22 and then to the broth processing system 34.

Figure 4 is a block diagram depicting the heat exchange system of the present invention 10 wherein heat is scavenged from heat -generating machinery such as the auxiliary tanks 28, the primary seafood boiler 22 and the broth processing system 34 and transferred to the dryers 30 by means of a warm air manifold 64. An air return system 32 returns the air from the dryers 30 and returns it to the heat generating machinery.

Figure 5 is a block diagram of the present invention 10 wherein the primary seafood boiler includes paddle wheels 60 and jetted water 16 to agitate the liquid and product 18 therein. Random product testing 68 is performed prior to introduction to the system and foreign substance/ chemical testing 70 is performed within the conk tank 14 to assure greater safety of the food product.

Quality control in the cooking process includes a plurality of automated tests and overseer devices such as gross weight monitoring 72, salinity monitoring sensors 74, product tracking means 84, timers 88, rheostats 86 and the like. The shellfish product 18 is moved from the primary seafood boiler 22 via the primary seafood boiler conveyor 92 which has a mesh like belt to move the product 18 to the dryer 30 while letting air pass through. High speed fans 76 above the primary seafood conveyor 92 blow air over the food as it travels there along to blow away the steam from the shellfish product 18 and cool it off to terminate the cooking process. A plurality of spreader bars 78 and rakes 80 serve to ensure that the seafood product 18 is evenly distributed over the conveyor 92. Heat is transferred from the primary seafood boiler 22 to the dryer 30 by a hot air manifold 64 and returned thereto for reheating by a hot air recovery & air circulation system 32.

Figure 6 is a block diagram of the dryer 30 and its related components including conveyor sensors 96 for monitoring how much product 18 is being transferred from the boiler 22 to the dryer 30. Thermostats and regulators 112 are provided for temperature control and humidity and moisture sensors 94 activate the conveyor rakes 80 to stir the product 18 during drying. Other such options to monitor and regulate the dryer 30 functions include video monitoring 110, rheostats 86, air contaminate sensors 108, air flow controls 106, and a timer 98 to determine product 18 rotation which activates conveyor causing product 18 to be dumped from the upper level of the chute to the lower level. Further options include a sanitizing system 100, a collection system 102, a built-in vacuum system 104, and video monitoring 110.

Figure 7 is a front view of the peeler 36 and additional options associated therewith. The stainless steel outer container 112 has an opening 130 at the top for manual unloading by dumping or vacuuming cleaned product 18 therethrough. The opening 130 is also used for the auto-loading device 122.

The spinning blade 128 may be fabricated of a wide variety of materials including stainless steel, aluminum, polymeric composites etc. The motor and power source 116 may be electrical, pneumatic or hydraulic. The screen 114 is constructed of a plain weave, single or double square screen or meshed material. The unloading device is a sectional piece of the screen which opens and allows the screen sweeper 126 to sweep cleaned product into the

opening 130 which jets air for extraction of product 18. The hopper 112 may be mounted on a mobile tilting unit 118 with a control panel 132 for manual dumping or on a stationary stand 120 with legs 121 for use with air induced loading 122 and unloading 124 devices.

FIGURES 8A - 8C is a block diagram of the seafood processing system of the present invention comprised of delivery to the conk tank, cleaning the shrimp in a conk tank, boiling the shrimp, drying the shrimp and peeling the shrimp. Anyone of these function can accomplished in whole or in part by the system of the present invention. Delivery of the shrimp to the conk tank 14 can be either manual or automated. In the automated method the shrimp is placed on either a conveyor belt 50 or product lifting unit 143 that either may have a dumping cage 58 forming an integral part therewith. The conk tank 14 is used to clean the seafood product and remove any foreign matter therefrom which may include sensor(s) for determining chemical contaminants. The conk tank 14 may also include apparatus to enhance processing of the seafood, such as water jets 16, raw product testing 46 dumping cage 58, paddle wheel 60, ice guard 62, random testing of product 68. Once the seafood product is cleaned, it is moved either manually or mechanically to a boiler. The boiler may be a conventional boiler with lift baskets 142 or conveyor 144 or the boiler system 22 of the present invention. Each of these may incorporate additional apparatus, such as auxiliary tanks 28 and/or hot air manifold 64 providing additional functions. In addition, other processes may extend from the boiling of the seafood product, such as processing the brine solution into a broth 34 or food flavoring 82. The boiler system, in either of the boiler and brine tanks includes at least one salinity monitor 74 for monitoring the salinity of the brine contained therein. Once boiled the seafood product is moved either manually or mechanically to a drying process. The drying process may include conventional dryer box with screened deck 146, spiral conveyor dryer 152, 154 or stacked conveyor dryer 148, 150 with each of these devices having additional apparatus, such as air return system 32, spreader bars 78, rakes 80, product tracking 84, aerated conveyor belt 90, conveyor sensors 96, sanitizing system 100, collection system 102, vacuum system 104, air flow control 1 06, air contaminate sensors 108 and video monitoring 110 for enhancing the functionality of the drying system. Once dried the product is transferred either manually or mechanically to a peeling process. The peeling process may include conventional tumbler peeler 135, peeler 136, and peeler 36 where each of these may include additional apparatus, such as loading device 1 22, screen sweeper 126, blade 128, tilting unit 118, stationary stand 120, unloading device 1 24, hopper 112 and screen access panel 138.

FIGURE 9 shows a block diagram of an additional element of the present invention comprising a brine broth processing system 34 wherein brine 24 from the brine mixing tank 26, auxiliary tanks 28 or salt is added to water and introduced into the aforementioned boilers and under predetermined conditions the broth 40 is moved to storage tank(s) 42 where it is packaged 48 as either a brine broth 34 or spray dried 82 and packaged 48 as one or more food additives or food products such as shellfish flavored oil and shellfish flavored salt as well as other uses.

FIGURES 10A and 10B is a block diagram showing another element of the present invention comprising a heat recovery system. The system recovers heat from the aforementioned boiler systems and broth system and recycles the heat to the aforementioned boiler systems and/or dryer systems 148, 150, 152 and 154 and/or peeling devices 36, 136.

FIGURE 11 is a block diagram showing another element of the present invention comprising processing of the byproduct shells and heads of the seafood process. As previously stated the seafood passes from the conk tank 14 to the boiler system 21 to the dryer 30 and peeler 36. The byproduct shells and heads are transferred to a product transfer system 38 and packaged for resale.

As shown throughout Figures 1 – 11 as described hereinabove, the present invention is an apparatus and system for cooking, drying and peeling shellfish products. The apparatus includes a fluid filled conk tank for separating the shellfish product from packing ice, sea shells and other such large objects. The conk tank is formed from a watertight housing having sidewalls and an open top. The conk tank has a substantial quantity of water retained within said housing and also includes means for agitating the water and objects having a predetermined lighter weight, such as shellfish product, associated therewith within conk tank. Alternatively, the conk tank has means for circulating water under pressure and means for testing raw seafood product positioned therein. Further in this alternate embodiment, the conk tank includes means for agitating the contents of the tank and means to prevent passage of ice while transferring raw seafood product therefrom. A sensor is provided for detecting foreign substances and chemicals within the tank.

The system also includes an automated means for transporting the crated product to the conk tank is provided. The automated means for transporting dumps the shellfish product into the conk tank from the crate and removes the crate therefrom. The automated transporting means comprises a conk tank conveyor system having a first loading end and a second dumping end. The dumping end extends above and beyond the edge of said conk tank. A dumping cage disposed proximal to the dumping end of the conveyor system is positioned in a manner conducive to catching the crate after it falls off the dumping end so the open top portion of the crate is oriented towards the conk tank thereby emptying the contents of the crate therein. The dumping cage is substantially open so as not to restrict passage therethrough of said shellfish product. The dumping cage is formed by a means for receiving the crated seafood product and means for displacing the crate whereby the crate is up-ended to discharge the contents thereof. Thereafter, a mechanical means for ejecting the crate from the dumping cage is included and the crate is removed from the system.

Additionally, the system of the present invention includes a boiler system for supplying heated brine and cooking the shellfish product therein as well as a mechanism for transferring the shellfish product from the conk tank to the boiler system. The boiler system includes a brine mixing tank including a means for introducing water therein and a means for introducing salt therein to create a brine solution of a predetermined concentration in which the shellfish product is to be cooked. A primary seafood boiler is provided to retain brine obtained from the brine mixing tank and maintain the brine at a constant, predetermined temperature. The primary boiler is able to agitate the brine and contents therein using at least one of wherein said agitation means includes at least one paddle wheel at the surface of the brine to keep the shellfish product moving evenly therethrough and at least one jet nozzle for circulating the brine and product within the boiler. Furthermore, the primary seafood boiler further includes a plurality of monitors positioned therein for monitoring a plurality of external factors associated with the brine therein. The plurality of monitors is able to at least one of monitor a specific temperature of the contents thereof thereby allowing the system to keep the brine therein at a predetermined desired temperature and monitoring the salinity of the mixture in which the product is being cooked. These monitors are also able to control and maintain the monitored factors at desired levels to ensure that the seafood is being cooked in an adequate brine mix.

A conduit is positioned and communicates between the brine mixing tank and the primary seafood boiler for the selective transport of brine to the primary mixing tank. Additionally, auxiliary boilers are provided in line with the conduit for heating the brine to the desired temperature and storing it therein until called for to replenish used brine that has been removed from said primary seafood boiler. The mechanism for transferring the shellfish product from the conk tank to the boiler is a substantially inclined conk tank conveyor having a first lower end located at a bottom portion of the conk tank positioned below the dumping cage and a second, upper end extending above and beyond the opposing sidewall of the conk tank housing so as to extend over the primary seafood boiler thereby permitting the shellfish product to fall therein upon reaching the end of said conk tank conveyor.

The apparatus and system also include at least one dryer for dehydrating the shellfish product. The shellfish product that is dried by the at least one dryer is transferred by a further transferring mechanism which transfers the shellfish product from the boiler to the dryer. The further transferring mechanism is a dryer conveyor. The dryer conveyor has a first lower end disposed at a bottom portion of the primary seafood boiler beneath the drop area of the conk tank conveyor and a second end extending over and beyond the opposing sidewall where the conveyor assumes a substantially horizontal orientation and terminates upon introduction to the dryer. Positioned over the dryer conveyor is a plurality of high speed fans blowing over the conveyor for cooling the shellfish product and stopping the cooking process. A plurality of spreader bars traversing the width of the conveyor and are disposed slightly thereabove. The plurality of spreader bars are positioned at a height sufficient to permit individual pieces of shellfish to pass thereunder but will prevent passage of stacked shellfish thereby ensuring that the shellfish product is evenly spread thereon for more efficient cooling thereof. Alternatively, or in addition to the spreader bars, the system may include a plurality of rakes for turning the shellfish product to further ensure the uniform cooling thereof. The rakes and/or spreader bars of the present invention are selectively activated by moisture sensors able to sense an amount of moisture in the shellfish product. Additionally, a plurality of rollers positioned vertically on top of one another and adjustably spaced apart from one another are positioned prior to entering the at least one dryer. The rollers are similar to a wringing device and are used for at least one of crushing and cracking the shells around the head of the shellfish product passing therethrough. This further cracking or crushing allows the dryer to dehydrate the shellfish more efficiently due to the existence of the moisture in the heads thereof as well as further aid the peeler device used to de-shell the shellfish after the

drying process. The further cracking or crushing also aids in preparing the shellfish for the peeling process. The rollers are selectively adjustable to be able to accommodate a plurality of different types of shellfish therein.

The dryers of the present invention also include a plurality of monitoring devices for monitoring at least one of temperature, toxin level, rheostats and moisture level of the shellfish product. An alarm and notification system is connected to each respective one of the plurality of sensors and is activated when the sensors sensed that a sensed condition is potentially hazardous. This alarm system is able to notify the operator of the present system so that the problem can be remedied. The operator is further able to monitor the status of the dryer by using a video monitoring apparatus which allows the operator to view the internal functionality of the dryers.

It is preferable that the seafood dryer conveyor is enclosed to prevent exposure to airborne contaminants as well as to prevent releasing any contaminants into the air. The cooling and drying process is further aided by the fact that a transport portion of the seafood dryer conveyor is composed of a mesh-like belting to permit the passage of air therethrough. The air flowing therethrough and around in the enclosed seafood dryer conveyor allows for a more uniform and efficient cooling process. Preferably, the present invention includes a plurality of dryers able to dehydrate a large amount of shellfish product in a short amount of time.

The dryers of the present invention are able to move and rotate the shellfish product within the dryers during the drying process. The mechanism for moving and rotating the shellfish product is a vertically stacked conveyor system having a plurality of staggered, parallel conveyors spaced apart one above the other and moving in alternating directions. The shellfish product is introduced into the dryer on the top conveyor and falls off upon reaching the end thereof and lands on the subjacent conveyor thereby effectively rotating the shellfish product. The product then travels in the opposite direction until falling onto a third conveyor subjacent to the second conveyor and the process continues as such until reaching the final conveyor that transports the shellfish product to at least one of another dryer and a peeling device. Alternatively, the mechanism for moving and rotating the product is a spiral platform having a substantially cylindrical chute extending medially therethrough wherein the orbital motion of the spiral platform spirals the shellfish product upwards until reaching the top

where the product enters the chute and falls to the bottom thereby rotating the product. This process is subsequently repeated when the product is reloaded onto the spiral platform as the cycle repeats. In the present invention, the plurality of drying devices described hereinabove may be use serially one after the other, wherein the piggybacked dryers are the same type of dryers. Alternatively, the piggybacked dryers can be different from one another.

An additional inventive aspect of the present invention is the manner in which the at least one dryer is supplied with heat for drying the shellfish product transported therein. The heat is supplied by capturing the heat generated by the boiling and broth systems and transferring the captured heat to the dryers. This occurs using a manifold integral with the boiler system and in communication with the dryers to scavenge the heat from the heat generating boilers and transfer it to the dryer. Additionally, an air return system is provided to return air to the boiler system from the dryers using fans or blowers to maintain constant air flow and recirculation. The dryer of the present invention may also include a spiral conveyor dryer in communication. The spiral dryer cycles the product from a low end to a high end as heated air is passed over the product before dropping the product back into the low end.

Also included in the drying process are a plurality of vacuums which are positioned along a bottom portion of the dryer to vacuum accumulated shells and shellfish product that may have fallen off the conveyors during the process. The dryers also preferably include sensors for detecting the moisture content within the shellfish product to ensure complete dehydration thereof and confirm that no traces pathogens are present in the product.

The present invention further includes a device for peeling the shellfish product which is transferred to the peeling device by a third transfer mechanism which moves the shellfish product from the dryer to the peeling device. The peeling device peels the shells from the shellfish product and also removes the heads and tails therefrom. The peeling device includes an inner compartment having a screened bottom and an outer compartment. A blade member spins within the inner compartment so that the cleaned shellfish product rides along smooth walls of the inner compartment while the heavier uncleaned shellfish product falls onto the screened bottom to continue cleaning of de-shelling process. A separation means for separating debris and shells from the finished product is performed by vacuum extraction and loading of any by-product into packages or drums. Optionally included and positioned within

the peeling device is the device for grading the final shellfish product by size as well as an auto-unload of finished product, a mobile tilting unit having a stationary stand, a screen sweeper and air jets. Alternatively, the peeling device includes a loading device, a screen sweeper, a blade and a tilting unit. The peeling device is positioned on a stationary stand and includes an unloading device.

The peeling device of the present invention requires additional components for more efficient peeling of certain shellfish product such as hard-shelled shellfish including but not limited to crawfish and rock shrimp. The peeler is able to at least partially peel the shells and remove the heads and tails of the crawfish but, as crawfish is a delicate crustacean, a complete peeling thereof would reduce the final product yield thereof. Therefore, the peeler further includes a mechanism for freezing the partially peeled shellfish product. A vacuum is able to move the product from the peeler to the freezing mechanism. The freezing mechanism may be a conventional freezer or a spiral freezer unit. The partially peeled shellfish is then frozen and then transported back to the peeler to complete the peeling cycle. The freezer causes the remainder of the shells to become brittle thereby allowing the shells to be more easily removed from the meat of the shellfish product. Another benefit realized by freezing the product after partial peeling thereof is an increase in the durability of the meat of the shellfish product when the product re-enters the peeling device. Alternatively, a second peeler connected in series with the freezer mechanism may be used to accomplish the second peeling and final removal of the shells from these shellfish products..

The present invention also includes a device for separating any shells and/or other large debris from the finish shellfish product thereby increasing the amount of product yielded from an initial amount of raw shellfish input into the system. Furthermore, the shells removed from the shellfish by the peeling device are able to be packaged for at least one of later use and disposal thereof. The shells are generally packaged along with dust that is emitted from the shellfish being transferred through the many phases and apparatus that makeup the present system.

While a conveyor system is described above and is used for transferring product between each of the conk tank and the boiler, the boiler and the dryer, and the dryer to an the peeler, a different mechanism can be used to perform the same function. This alternate mechanism is a suction used to vacuum the shellfish product from one device to another.

Another aspect of the present invention is a broth processing system wherein used brine is extracted from the primary seafood boiler and transported to the broth processing system for preparation into a seafood flavored broth. This finished broth product is selectively storable in a plurality of broth storage tanks. The stored broth is able to be packaged by a broth packaging system. The packaged broth is then able to be commercially sold for consumer use thereof. The broth processing system allows for the brine solution from a seafood boiler to be transported to holding tanks prior to packaging as a brine broth.

Additionally, the present invention provides a spray drying system for utilizing brine to form flavored salt product. The spray drying system allows for used brine extracted from the primary seafood boiler to be injected as a fine mist into a heated furnace where instantaneous crystallization occurs creating a solid product to be used as a seafood flavored salt.

An additional feature included in the present invention is a mechanism and method for producing consumable food product such as a shellfish flavored oil. This element of the present invention utilizes the by-product of the shellfish obtained from the peeling process. The by-product of the peeling process includes the heads, tails, legs and shells of the shellfish that are removed by the peeler device(s). These by-products are transported, preferably by vacuum to ensure maximum yield, from the peeling device to a hopper which is further connected to at least one of a mill and grinder. The mill and grinder pulverizes the heads, legs and shells releasing meat remaining in the cavities of the shellfish. The meat released contain a distinct flavor associated with the shellfish that is being processed. This pulverized product having the shellfish flavor is then added to a container having a neutral oil contained therein. The neutral oil used include but are not limited to at least one of soy, canola, vegetable, olive and medium chain triglyceride oil (MCT oil). A heating device is included and positioned under the container having the oil and provides heat to the mixture of pulverized shellfish by product and neutral oil. The oil is then heated on a low heat for a predetermined amount of time. A filtering device is included for filtering the heated mixture therethrough to produce a seafood flavored oil. Preferably, the filtering device is at least one of a cheese cloth of fine screening device. Thereafter, the seafood flavored oil is cooled for packaging thereof. An additional device for adding a further flavor element may also be included thereby providing the seafood flavored oil with a further flavor. The further flavor

element added to the oil includes but is not limited to at least one of garlic, butter, spices, and lemon. These further flavor elements are provided for example only and any flavor able to be added for human consumption can be added to the seafood flavor oil.

The system and apparatus of the present invention is selectively controllable using a computerized monitoring system and central data base which oversees all operational phases of the present invention that may include. The computerized monitoring system is able to control at least one of video and audio monitoring of the system to ensure proper functionality. The computerized monitoring system also allows the operator to detect chemicals contained within the system at a plurality of different points therein as well as allowing the operator to track the progress of the product. A further option provided by the computerized monitoring system is to control production schedules, the yield of the product, and monitoring the gross weights of product. As described above, the moisture content sensors, heat sensors for air and water, heat, water and air flow control system, rheostats and salinity monitoring are also controlled by the computerized monitoring system. The computer monitor further controls the operation of and a timing mechanism connected to each the boiling, drying and peeling devices. The system further allows the operator to ensure that all Hazardous Analysis Critical Control Point (HACCP) guidelines and regulations as well as FDA, Dept. of Health, requirements are being complied with as well as producing inspection and production forms to aid these organizations. This allows for the system of the present invention to monitor quality control and to troubleshoot any problems that occur within the system.

The system of the present invention also includes a method for processing raw seafood product. The method of using the above described system incorporates the functional use of each element described hereinabove.

It will be understood that each of the elements described above, or two or more together may also find a useful application in other types of methods differing from the type described above.

While certain novel features of this invention have been shown and described and are pointed out in the annexed claims, it is not intended to be limited to the details above, since it will be understood that various omissions, modifications, substitutions and changes in the

forms and details of the device illustrated and in its operation can be made by those skilled in the art without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.